FIG.1

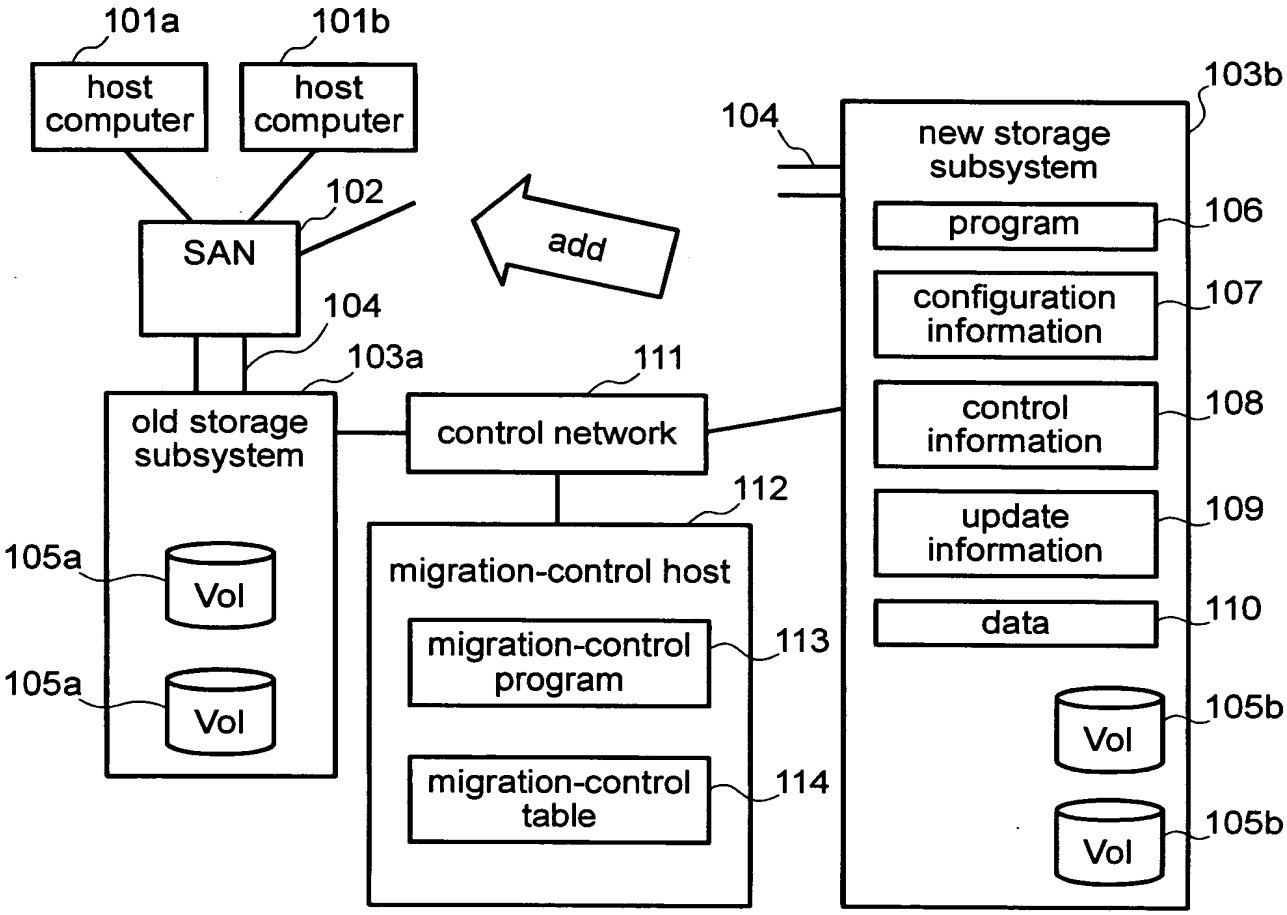

101a
101b
host computer
host computer
SAN
102
104
103a
old storage subsystem
105a
Vol
105a
Vol
add
104
103b
new storage subsystem
program
106
configuration information
107
control information
108
update information
109
data
110
105b
Vol
105b
Vol
111
control network
112
migration-control host
migration-control program
113
migration-control table
114

FIG.2

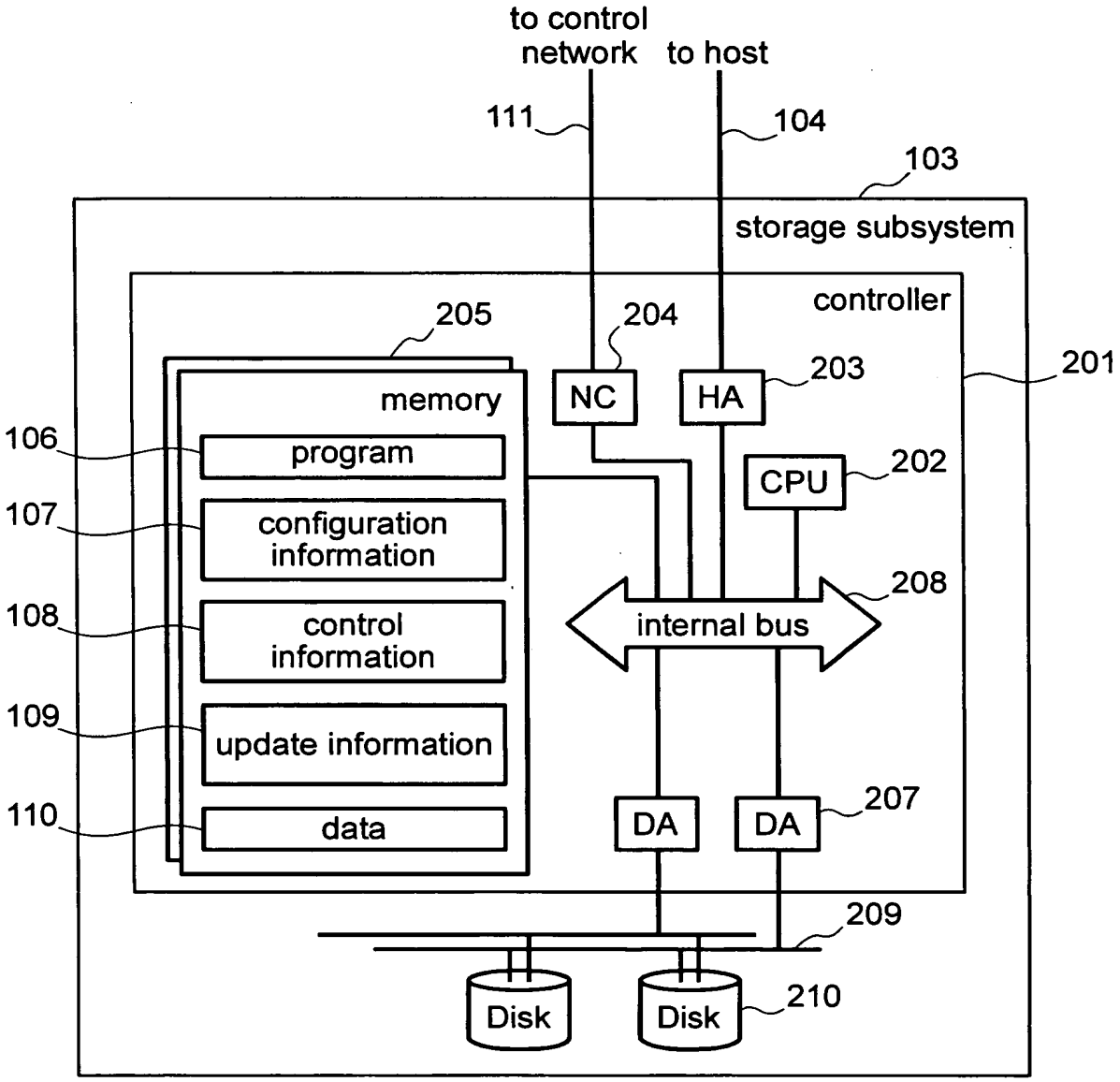

to control network
to host
111
104
103
storage subsystem
controller
205
204
203
201
memory
NC
HA
106
program
CPU
202
107
configuration information
208
108
control information
internal bus
109
update information
110
data
DA
DA
207
209
Disk
Disk
210

FIG.3

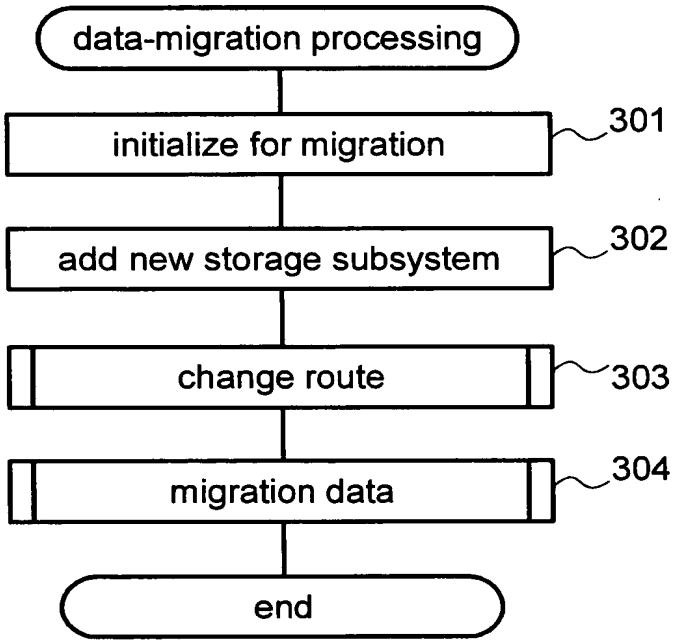

data-migration processing
initialize for migration
301
add new storage subsystem
302
change route
303
migration data
304
end

FIG.4

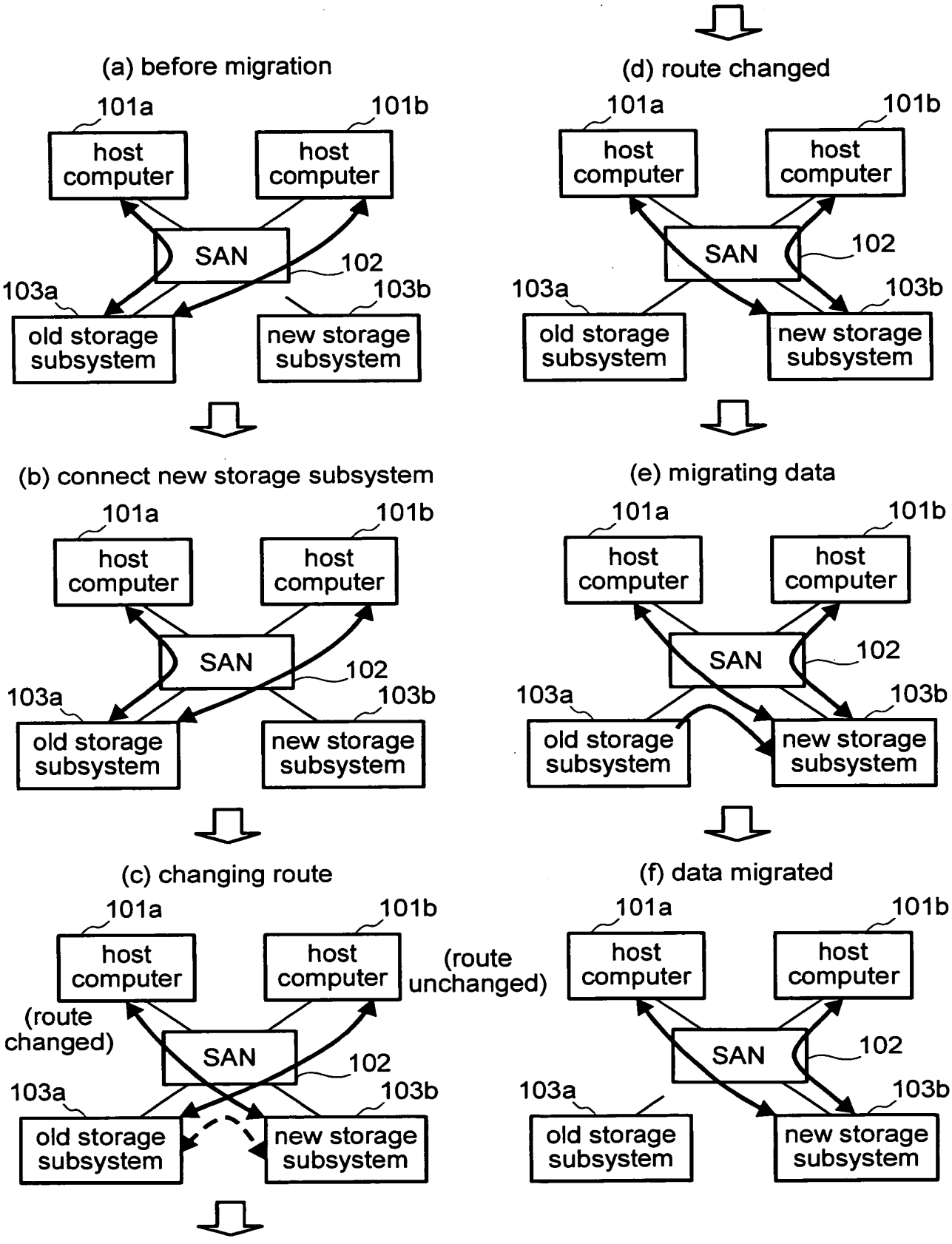

(a) before migration
101a
101b
host computer
host computer
SAN
102
103a
103b
old storage subsystem
new storage subsystem
(b) connect new storage subsystem
(c) changing route
(route changed)
(route unchanged)
(d) route changed
(e) migrating data
(f) data migrated

FIG.5

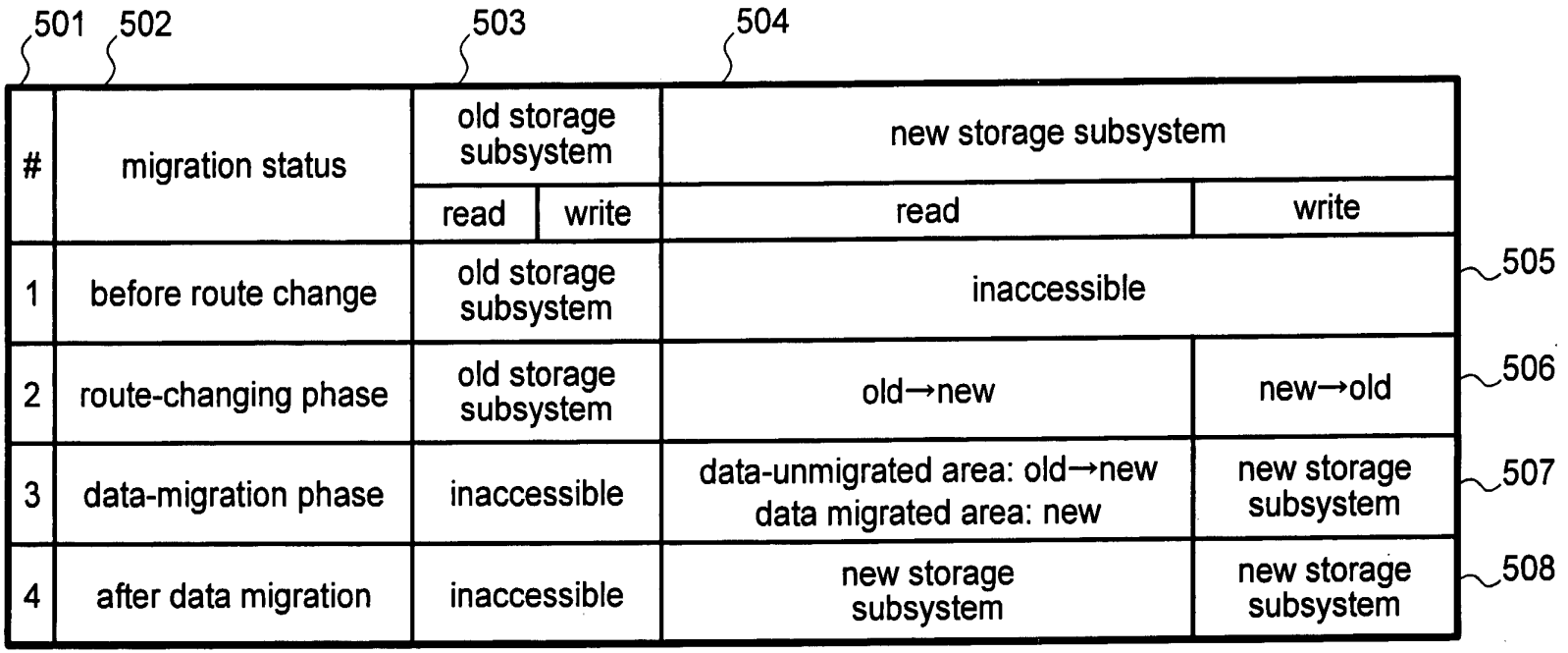
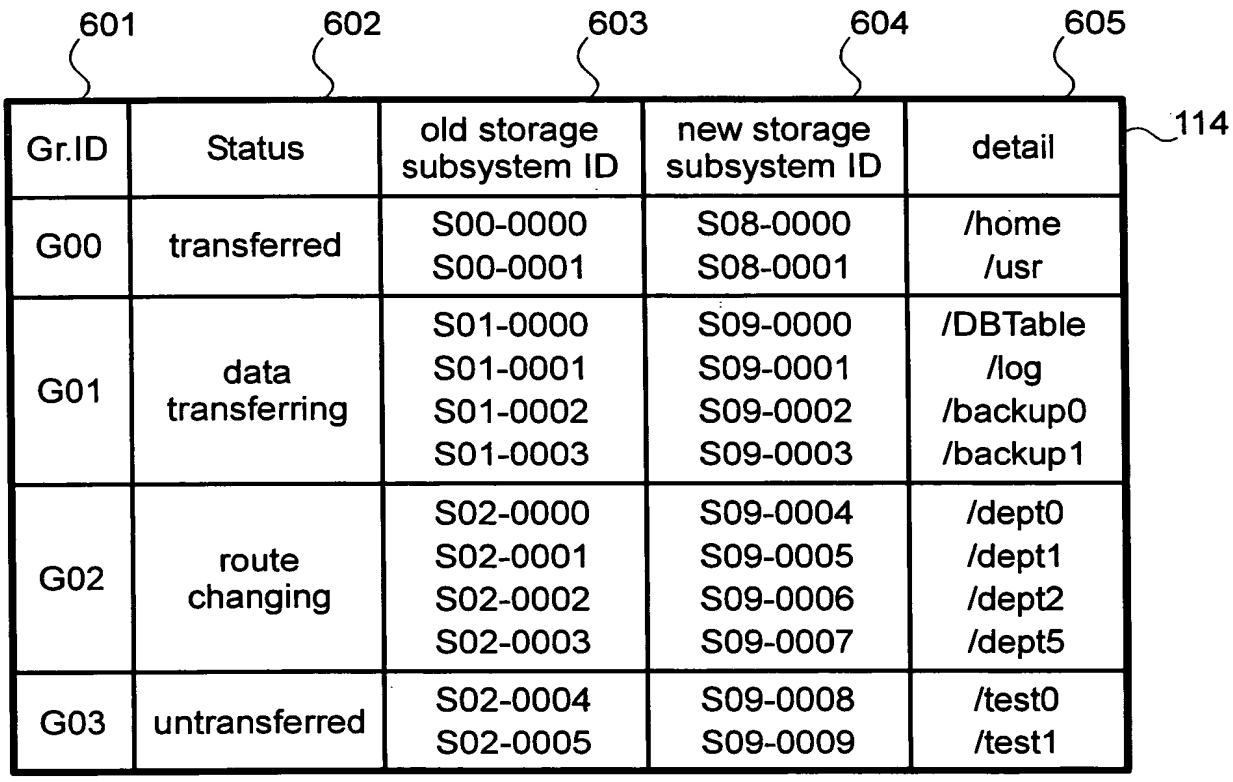

501
502
503
504
#
migration status
old storage subsystem
new storage subsystem
read
write
read
write
1
before route change
old storage subsystem
inaccessible
505
2
route-changing phase
old storage subsystem
old→new
new→old
506
3
data-migration phase
inaccessible
data-unmigrated area: old→new
data migrated area: new
new storage subsystem
507
4
after data migration
inaccessible
new storage subsystem
new storage subsystem
508

FIG.6



Gr.ID	Status	old storage subsystem ID	new storage subsystem ID	detail
G00	transferred	S00-0000 S00-0001	S08-0000 S08-0001	/home /usr
G01	data transferring	S01-0000 S01-0001 S01-0002 S01-0003	S09-0000 S09-0001 S09-0002 S09-0003	/DBTable /log /backup0 /backup1
G02	route changing	S02-0000 S02-0001 S02-0002 S02-0003	S09-0004 S09-0005 S09-0006 S09-0007	/dept0 /dept1 /dept2 /dept5
G03	untransferred	S02-0004 S02-0005	S09-0008 S09-0009	/test0 /test1

FIG.7

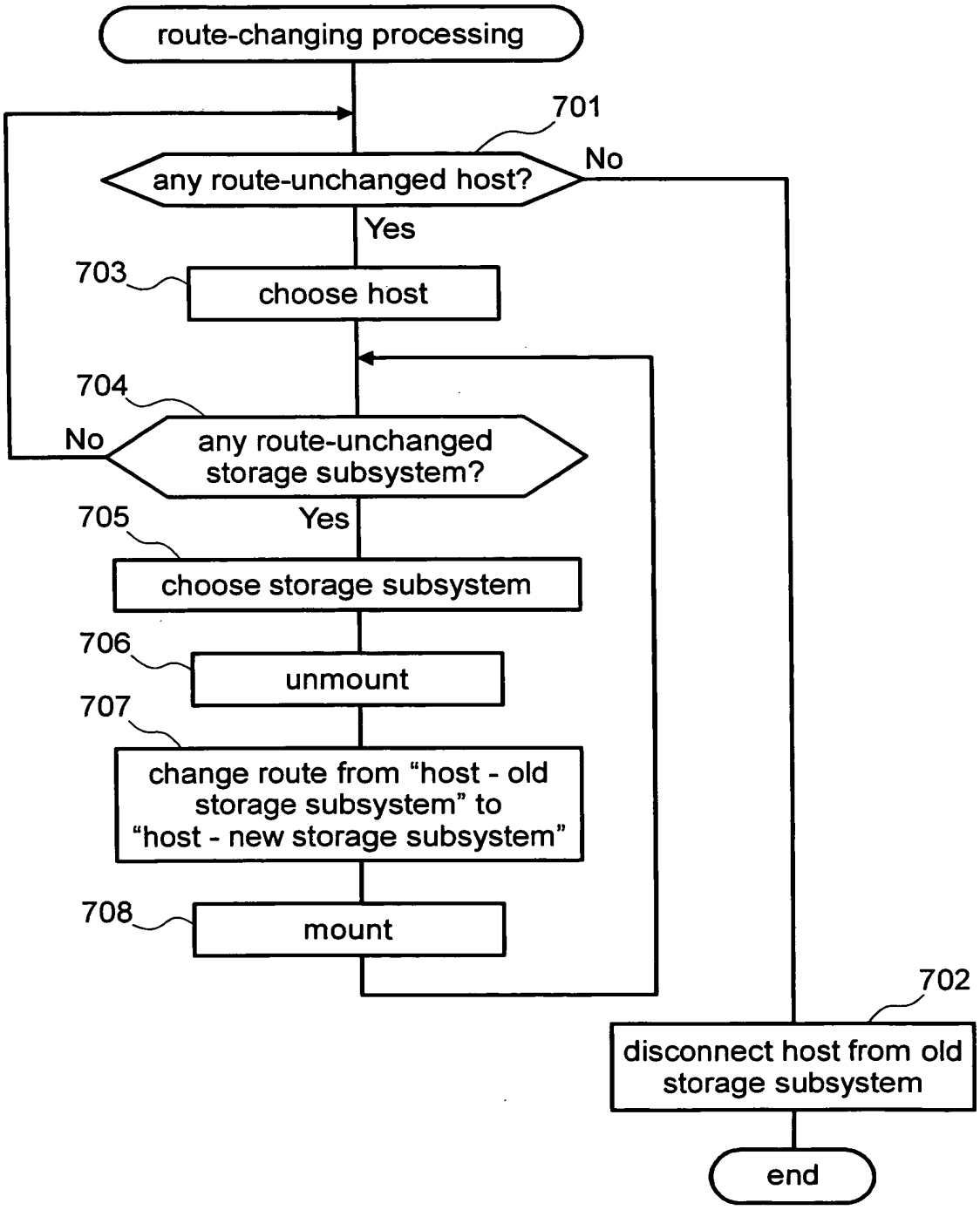

route-changing processing
701
any route-unchanged host?
No
Yes
703
choose host
704
No
any route-unchanged storage subsystem?
705
Yes
choose storage subsystem
706
unmount
707
change route from "host - old storage subsystem" to "host - new storage subsystem"
708
mount
702
disconnect host from old storage subsystem
end

FIG.8

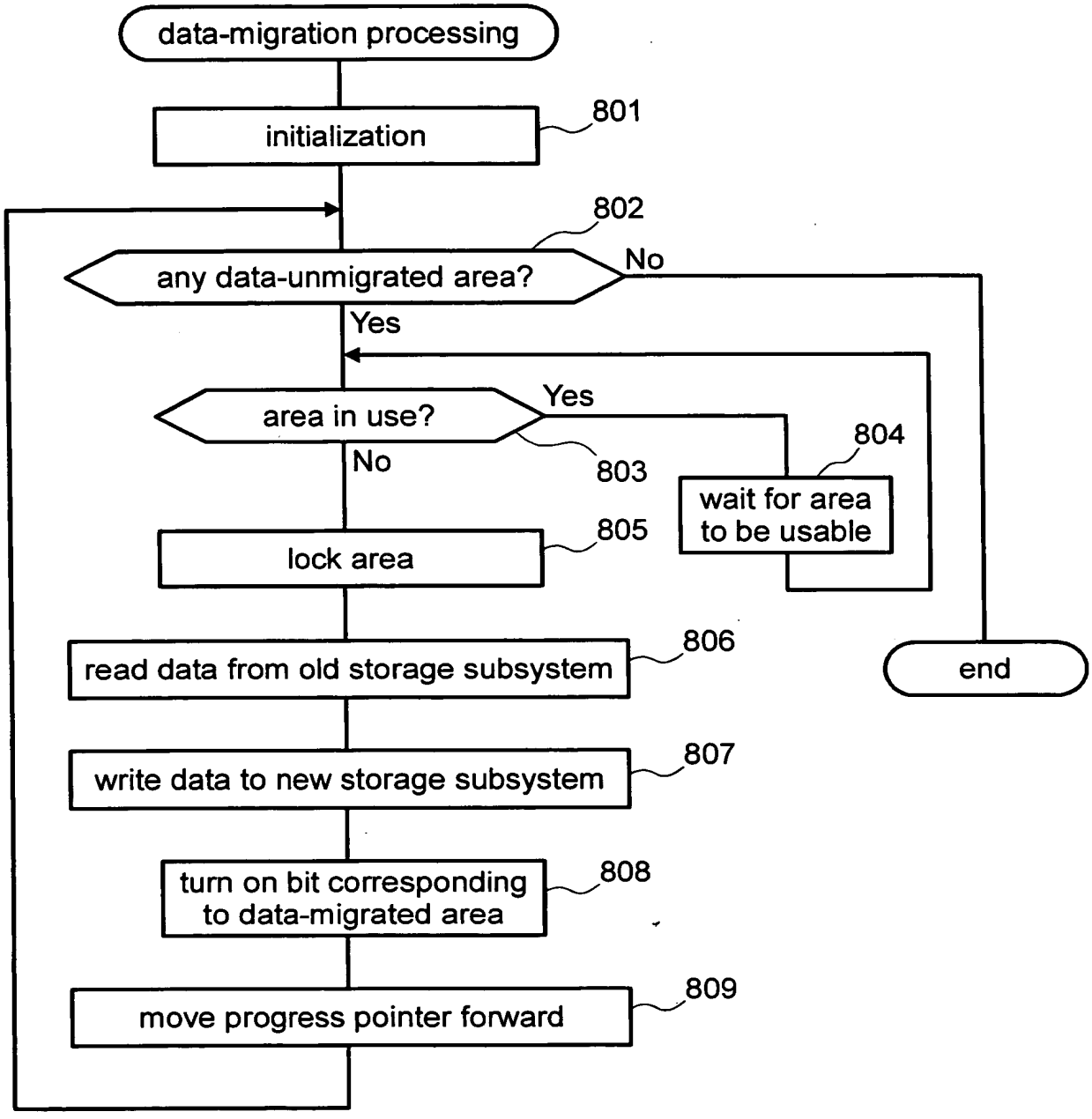
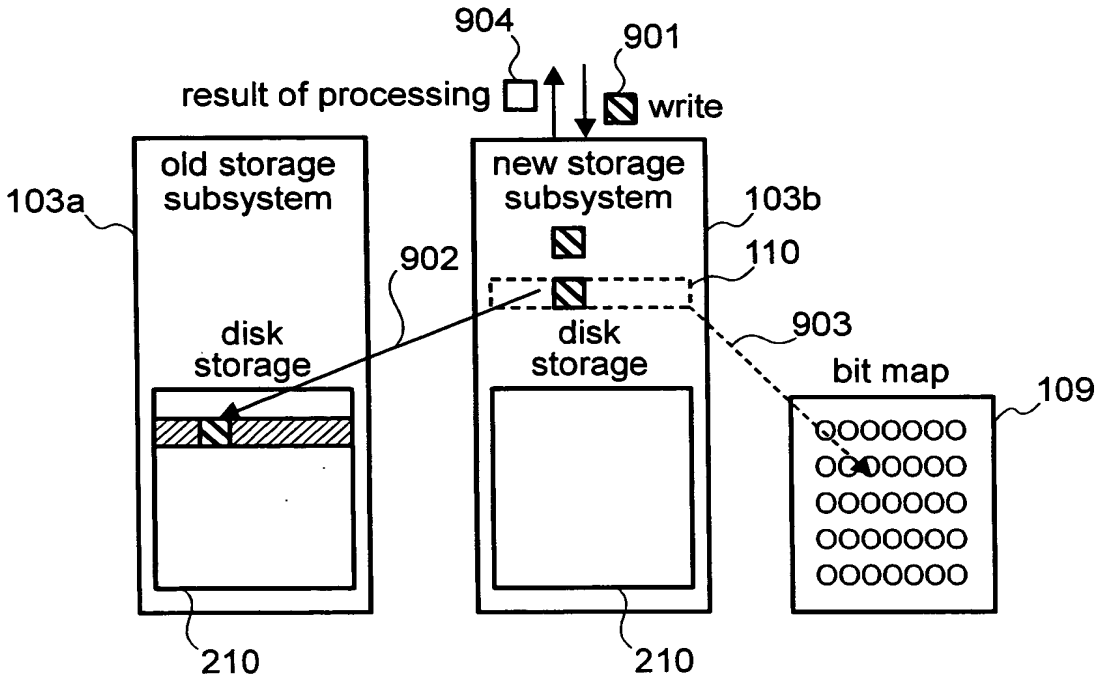

data-migration processing
initialization
801
802
any data-unmigrated area?
No
Yes
area in use?
Yes
804
803
No
wait for area to be usable
805
lock area
806
read data from old storage subsystem
end
807
write data to new storage subsystem
808
turn on bit corresponding to data-migrated area
809
move progress pointer forward

FIG.9

(a) route-changing phase



(b) data-migration phase (processing to data-unmigrated area)

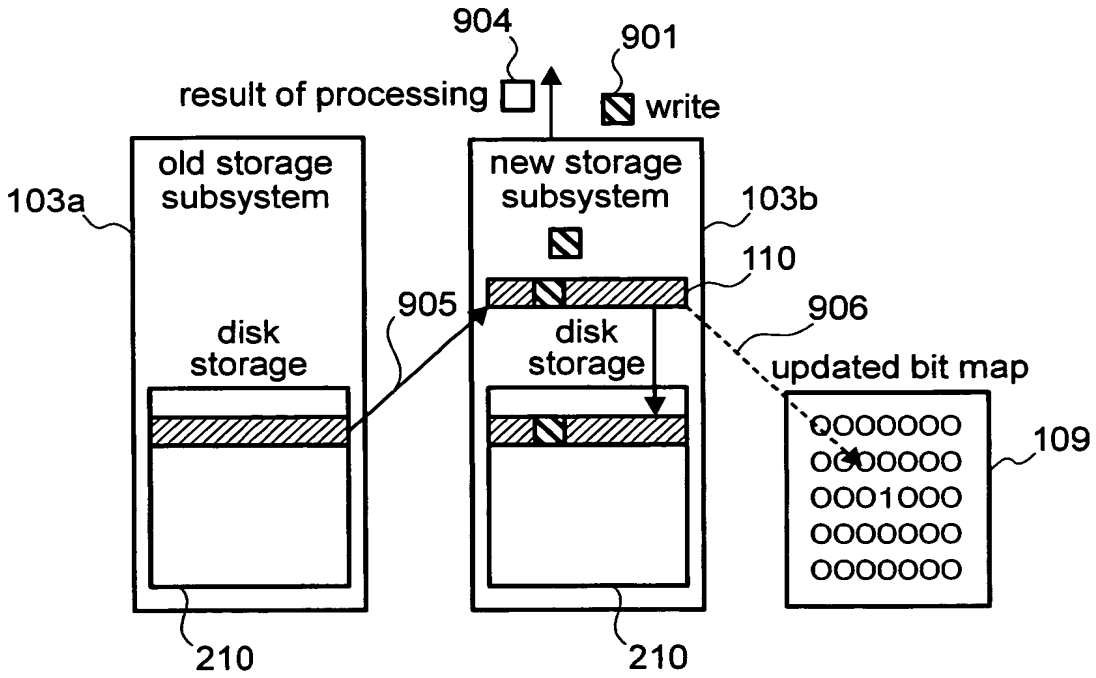


FIG.10

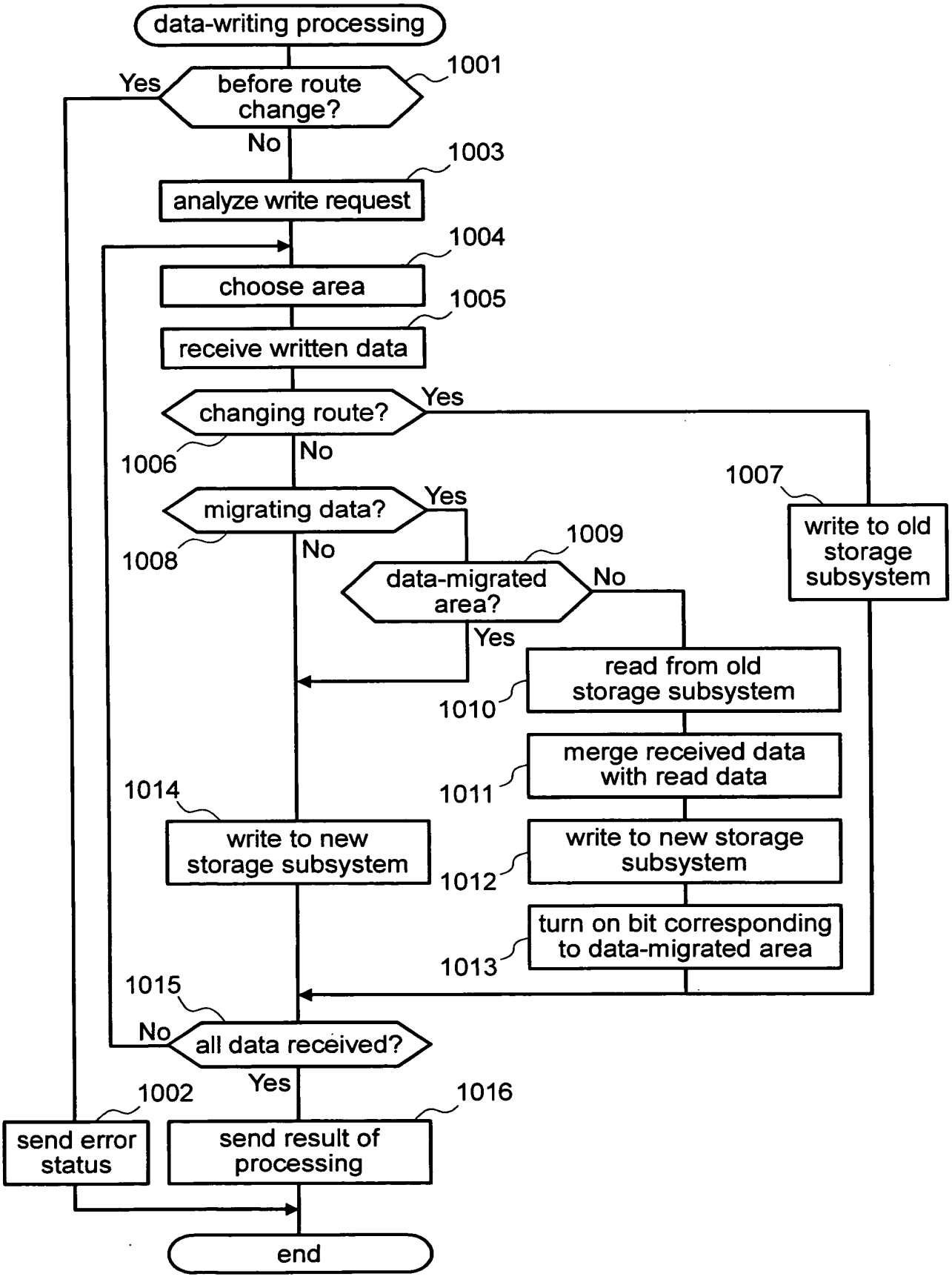
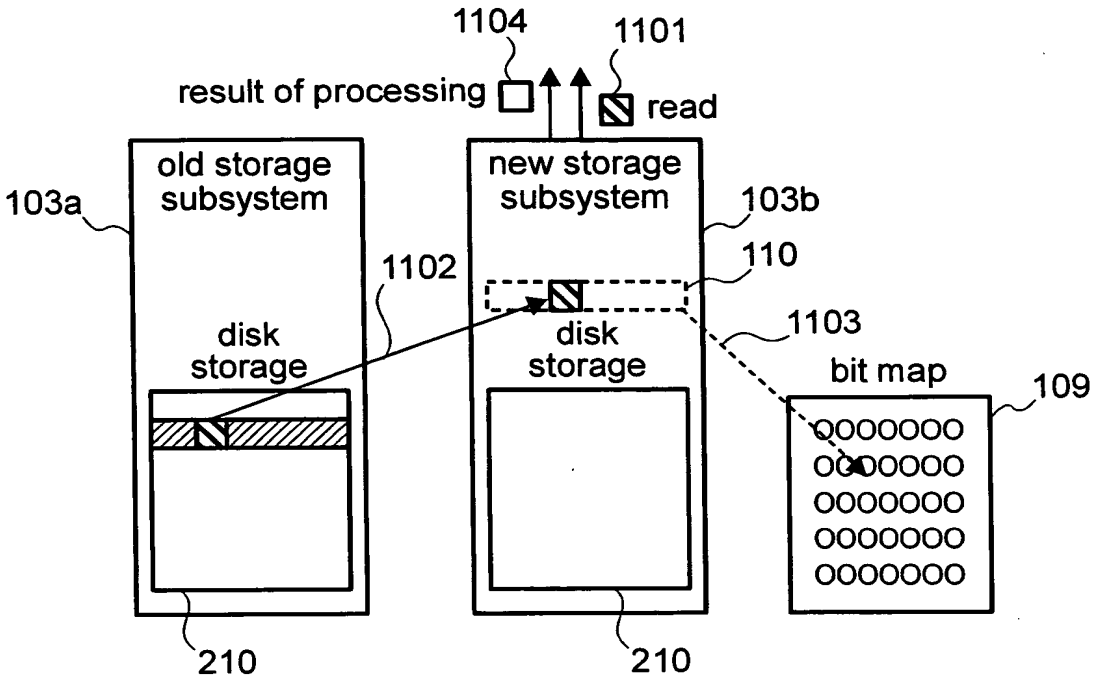

data-writing processing
1001
before route change?
Yes
No
1003
analyze write request
1004
choose area
1005
receive written data
changing route?
Yes
1006
No
1007
write to old storage subsystem
migrating data?
Yes
1008
No
1009
data-migrated area?
No
Yes
read from old storage subsystem
1010
merge received data with read data
1011
1014
write to new storage subsystem
write to new storage subsystem
1012
turn on bit corresponding to data-migrated area
1013
1015
No
all data received?
Yes
1002
send error status
1016
send result of processing
end

FIG.11

(a) route-changing phase



(b) data-migration phase (processing to data-unmigrated area)

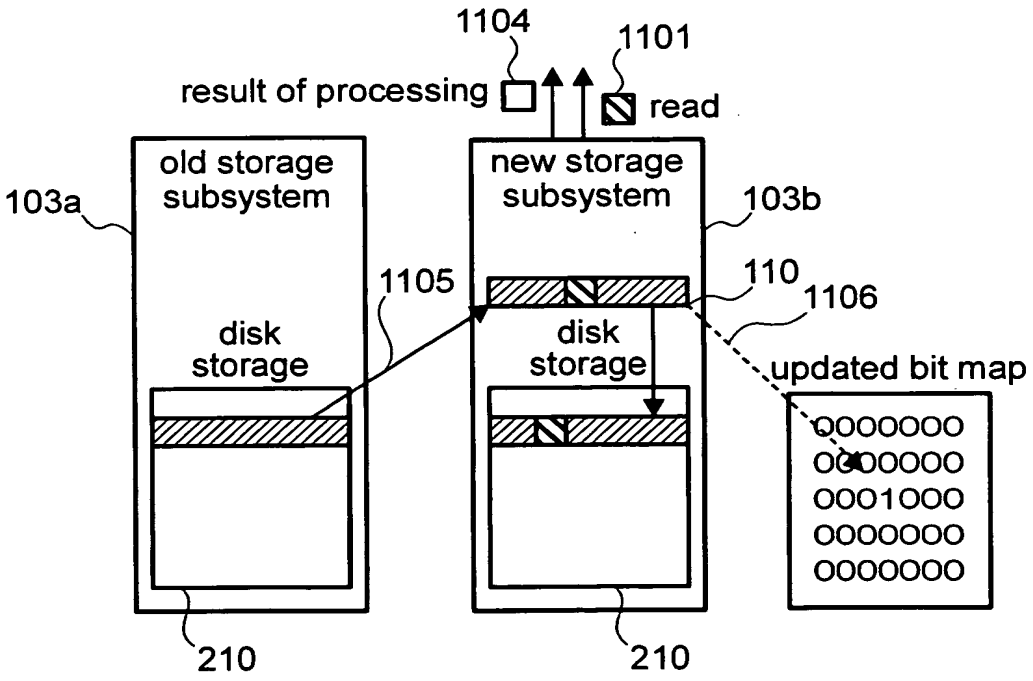


FIG.12

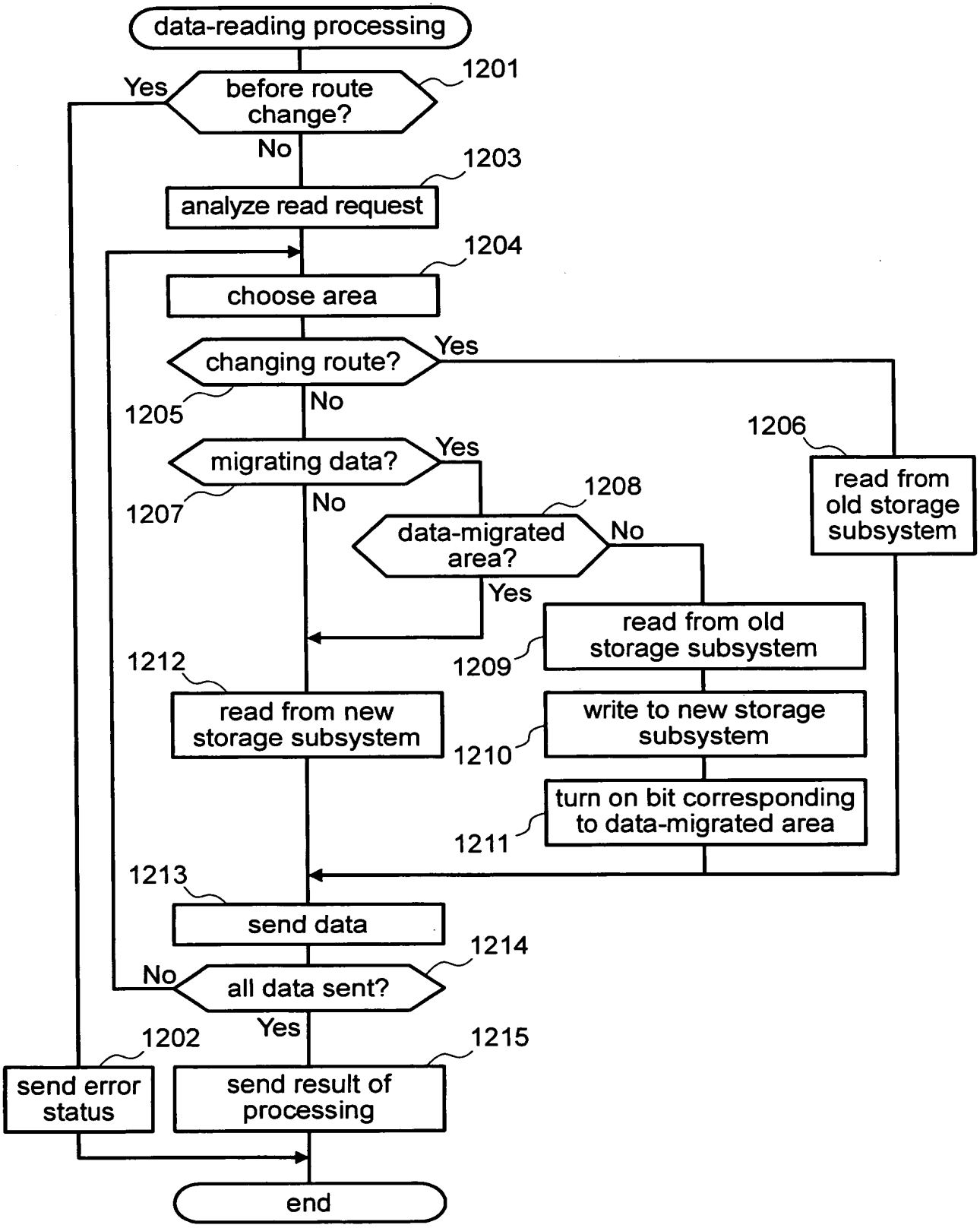

data-reading processing
1201
before route change?
Yes
No
1203
analyze read request
1204
choose area
changing route?
Yes
1205
No
1206
migrating data?
Yes
1207
No
1208
data-migrated area?
No
read from old storage subsystem
Yes
1209
read from old storage subsystem
1212
read from new storage subsystem
1210
write to new storage subsystem
1211
turn on bit corresponding to data-migrated area
1213
send data
1214
No
all data sent?
Yes
1202
send error status
1215
send result of processing
end

FIG.13

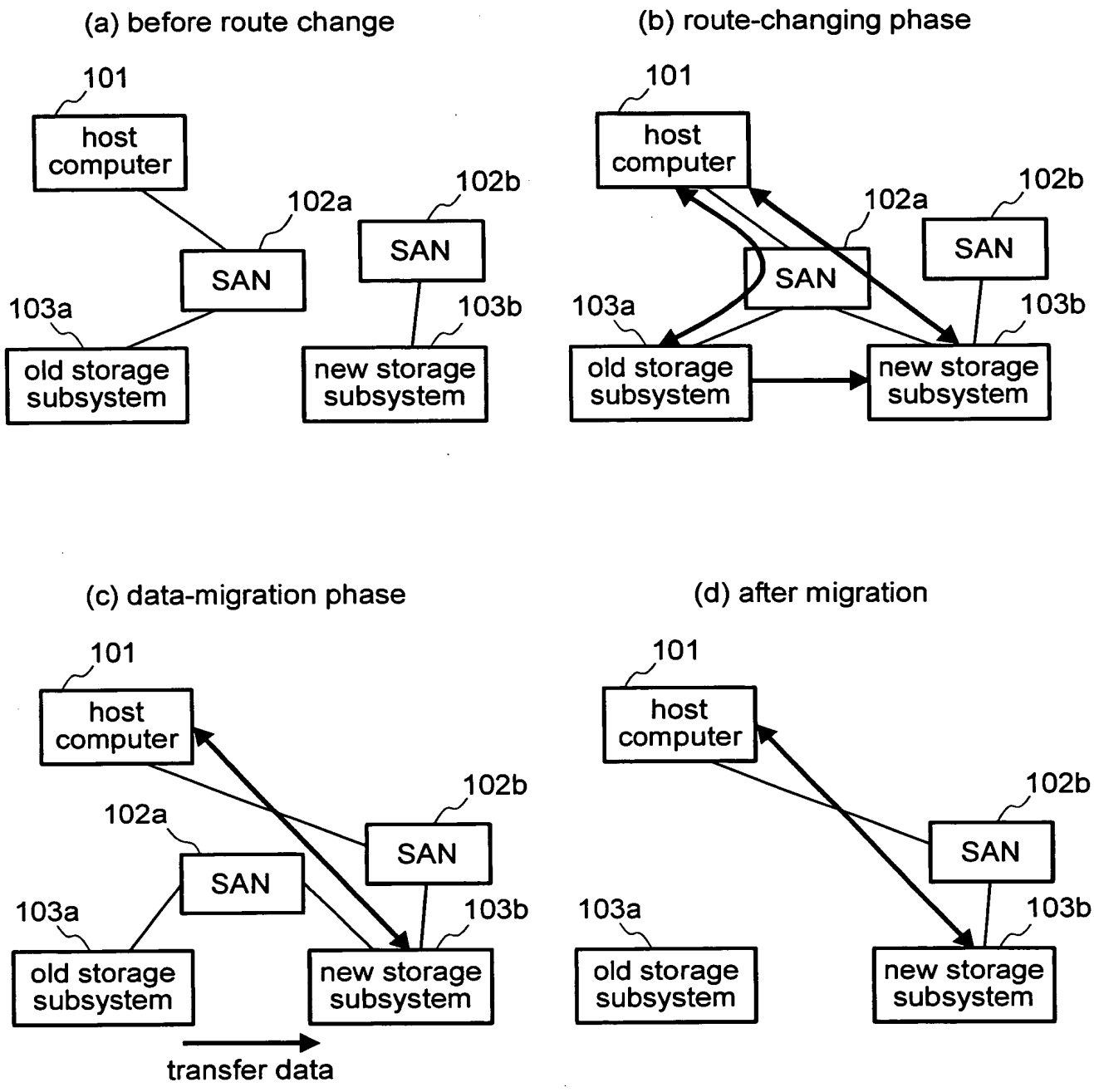

(a) before route change
101
host computer
102a
SAN
102b
SAN
103a
103b
old storage subsystem
new storage subsystem
(b) route-changing phase
101
host computer
102a
SAN
102b
SAN
103a
103b
old storage subsystem
new storage subsystem
(c) data-migration phase
101
host computer
102b
SAN
102a
SAN
103a
103b
old storage subsystem
new storage subsystem
transfer data
(d) after migration
101
host computer
102b
SAN
103a
103b
old storage subsystem
new storage subsystem

FIG.14

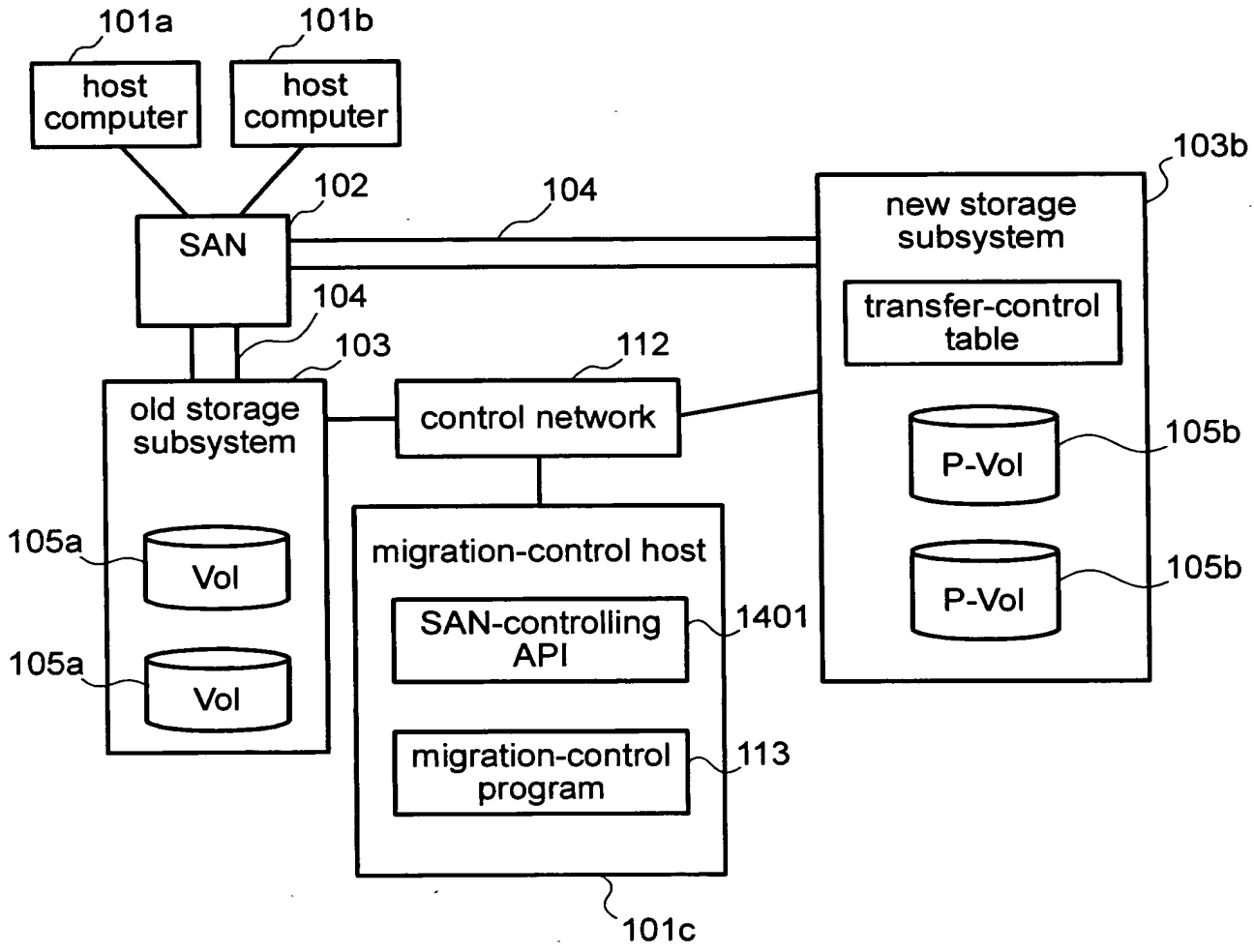

101a
101b
host computer
host computer
SAN
102
104
104
103
112
103b
new storage subsystem
transfer-control table
old storage subsystem
control network
P-Vol
105b
105a
Vol
migration-control host
SAN-controlling API
1401
P-Vol
105b
105a
Vol
migration-control program
113
101c

FIG.15

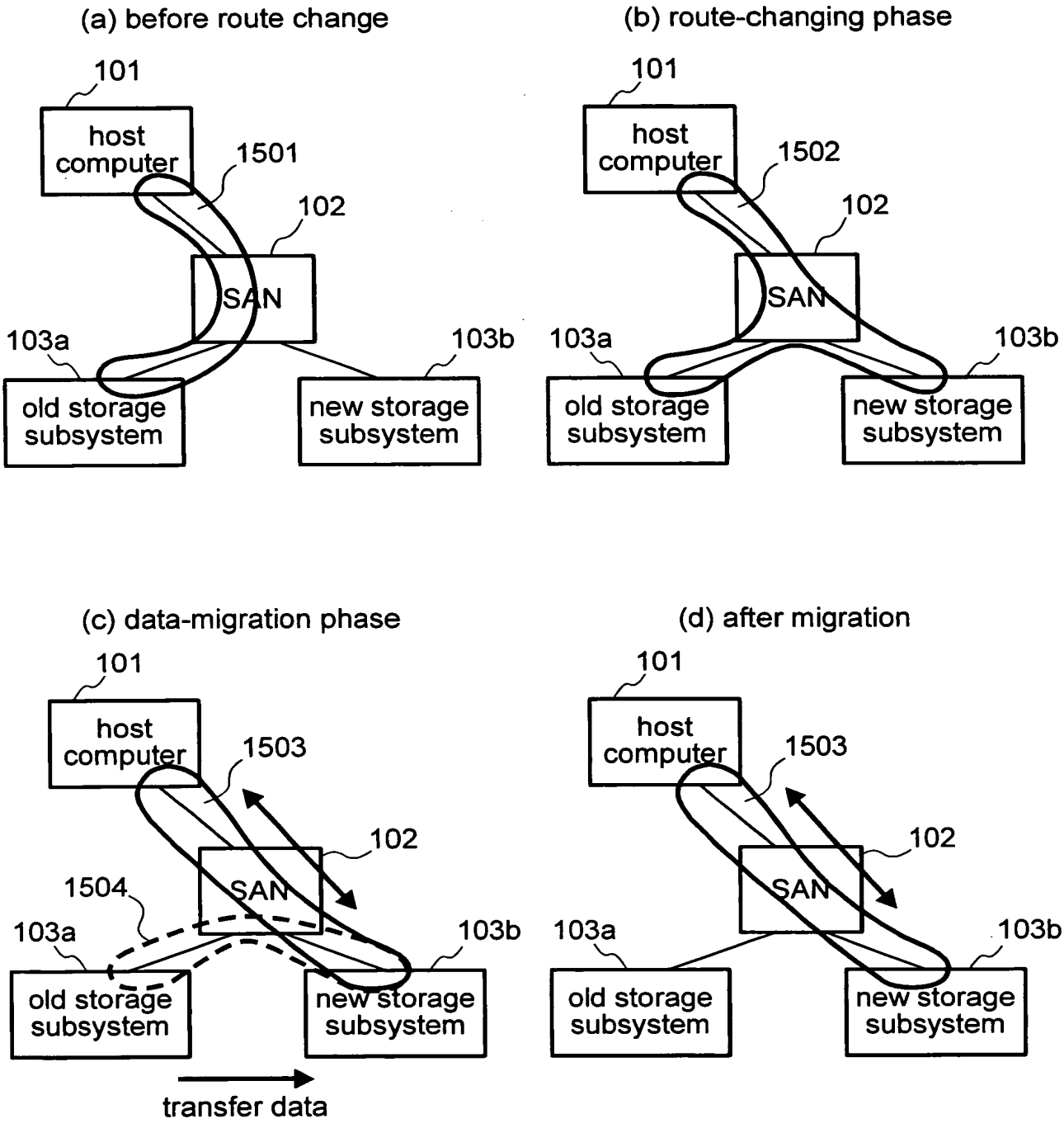

(a) before route change
101
host computer
1501
102
SAN
103a
103b
old storage subsystem
new storage subsystem
(b) route-changing phase
101
host computer
1502
102
SAN
103a
103b
old storage subsystem
new storage subsystem
(c) data-migration phase
101
host computer
1503
102
SAN
1504
103a
103b
old storage subsystem
new storage subsystem
transfer data
(d) after migration
101
host computer
1503
102
SAN
103a
103b
old storage subsystem
new storage subsystem

FIG.16

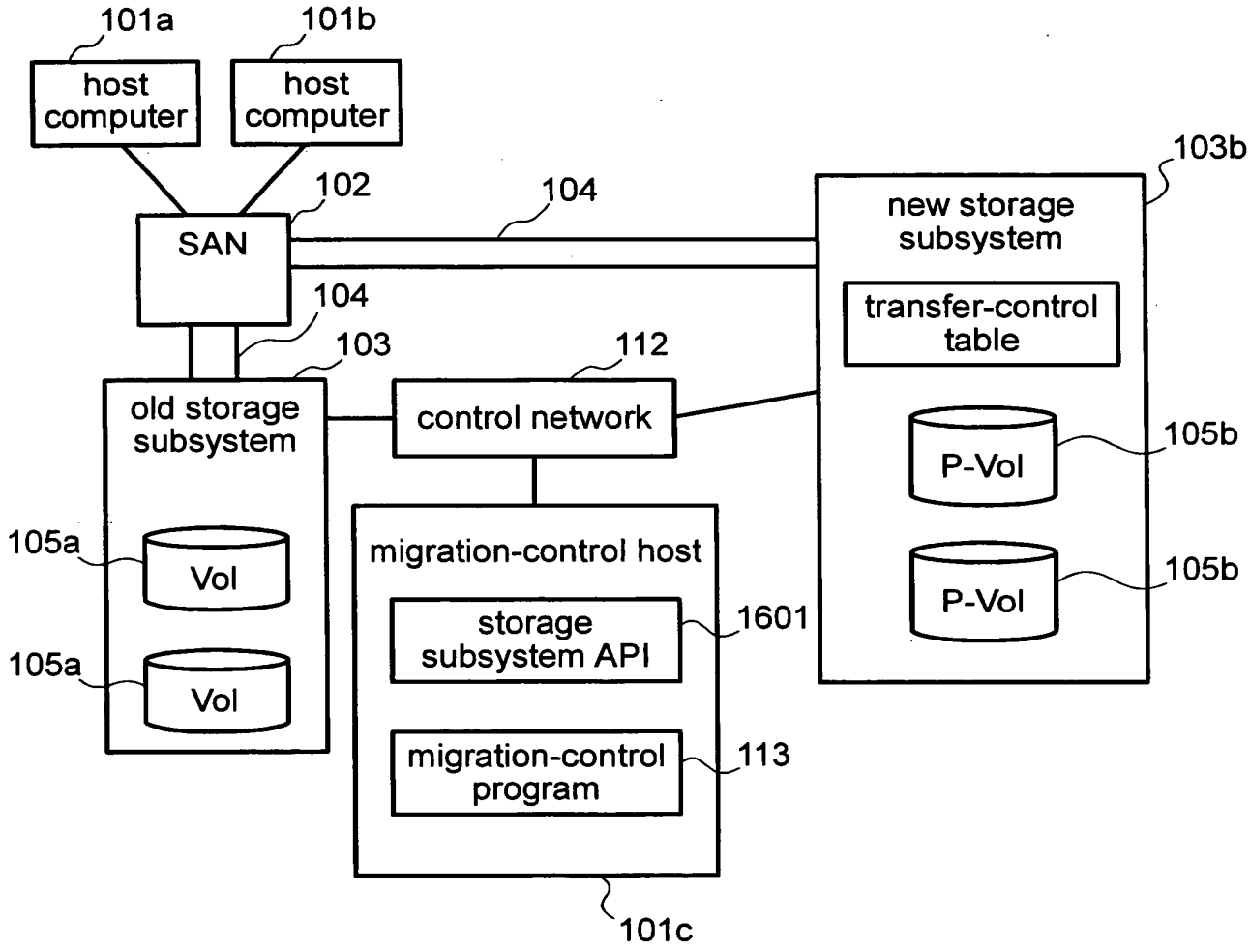

101a
101b
host computer
host computer
SAN
102
104
104
103
112
103b
new storage subsystem
transfer-control table
old storage subsystem
control network
105b
P-Vol
105a
Vol
105b
P-Vol
105a
Vol
migration-control host
storage subsystem API
1601
migration-control program
113
101c

FIG.17

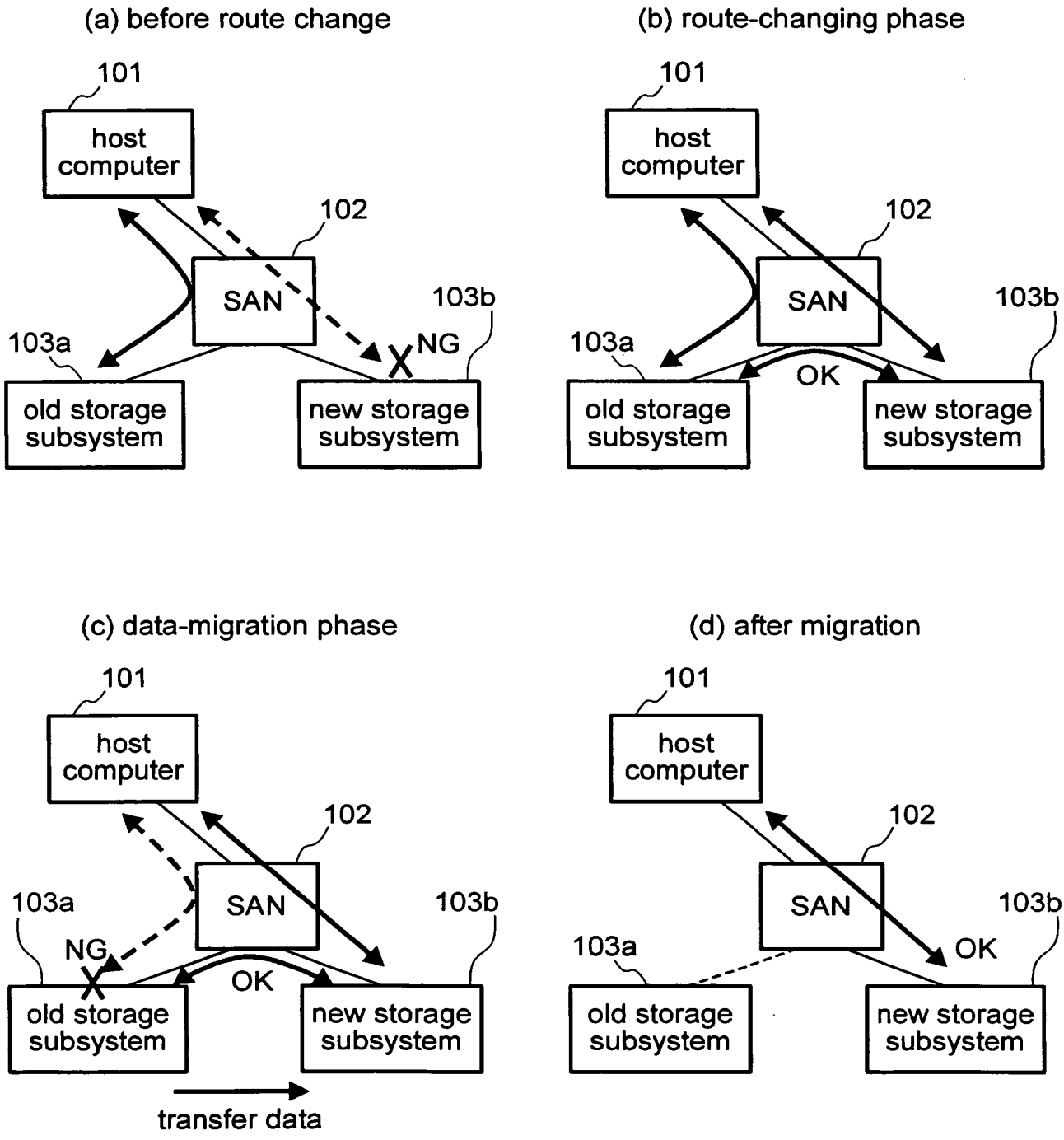

(a) before route change
101
host computer
102
SAN
103b
103a
NG
old storage subsystem
new storage subsystem
(b) route-changing phase
101
host computer
102
SAN
103b
103a
OK
old storage subsystem
new storage subsystem
(c) data-migration phase
101
host computer
102
103a
SAN
103b
NG
OK
old storage subsystem
new storage subsystem
transfer data
(d) after migration
101
host computer
102
SAN
103b
103a
OK
old storage subsystem
new storage subsystem

FIG.18

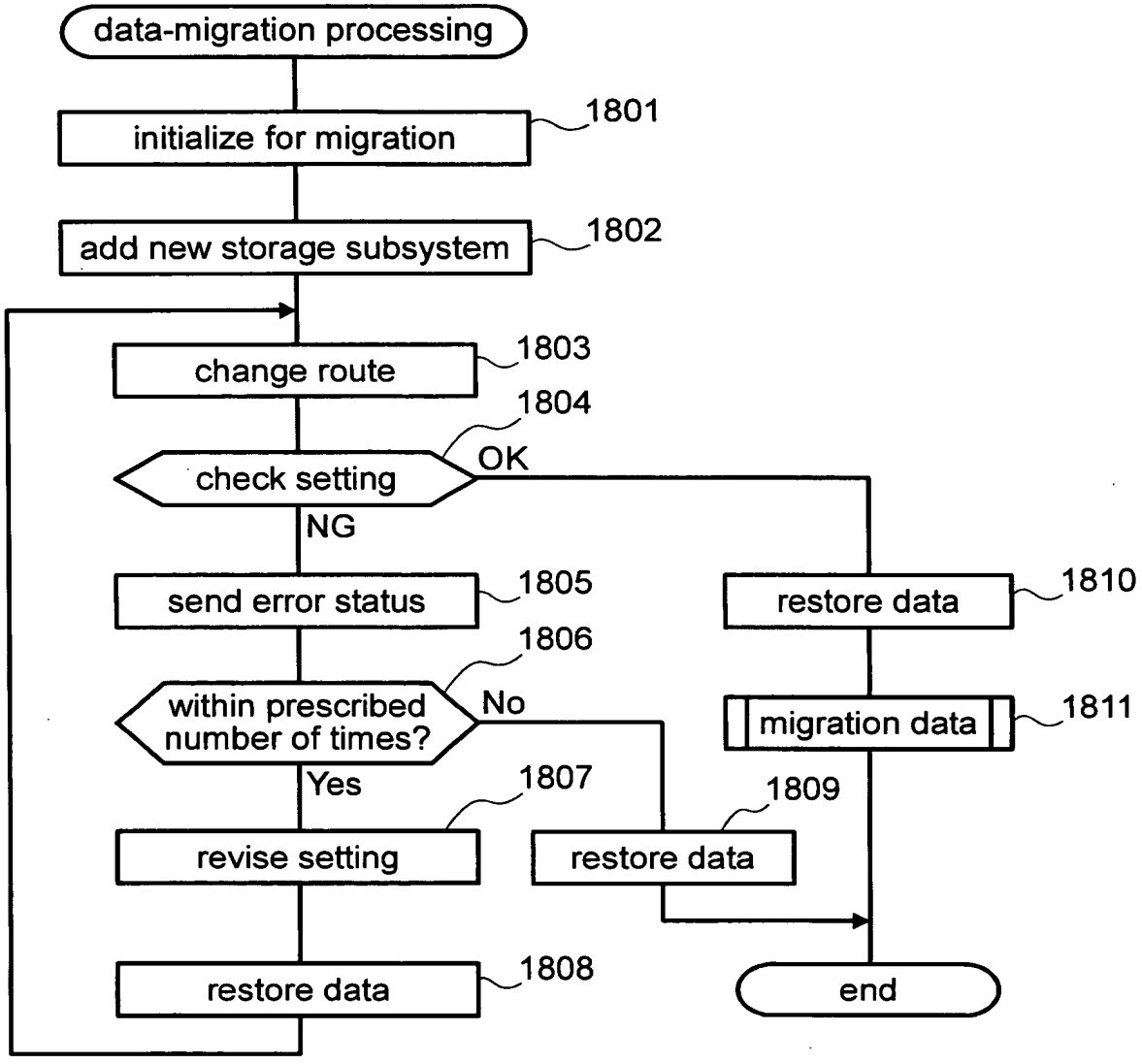
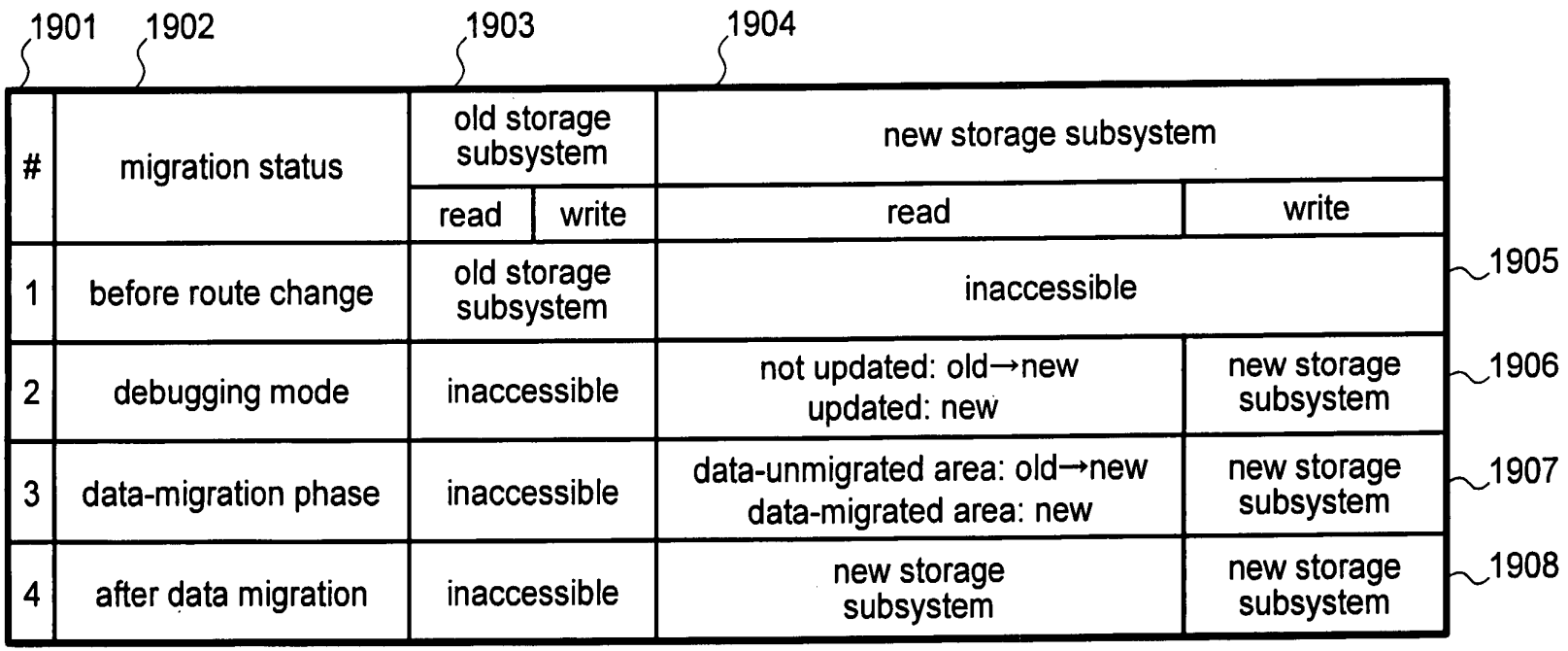

data-migration processing
initialize for migration
1801
add new storage subsystem
1802
change route
1803
check setting
1804
OK
NG
send error status
1805
within prescribed number of times?
1806
No
Yes
revise setting
1807
restore data
1808
restore data
1809
restore data
1810
migration data
1811
end

FIG.19



#	migration status	old storage subsystem		new storage subsystem		
		read	write	read	write	
1	before route change	old storage subsystem		inaccessible		1905
2	debugging mode	inaccessible		not updated: old→new updated: new	new storage subsystem	1906
3	data-migration phase	inaccessible		data-unmigrated area: old→new data-migrated area: new	new storage subsystem	1907
4	after data migration	inaccessible		new storage subsystem	new storage subsystem	1908